PATENT APPLICATION

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

In re application of

Ian David KAEHNE — Confirmation No. 5455

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Attn: RCE
Commissioner for Patents
P. O. Box 1450
Alexandria, VA 22313-1450

Sir:

I, Ian David Kaehne, 6 Wattle Grove, Belair, South Australia, Australia, declare and state the following:

In 1969, I graduated from the University of Adelaide with a Bachelor Degree in Agricultural Science. In 1977 I was awarded a Master degree of Agricultural Science by the University of Adelaide for my dissertation entitled "Studies on waterlogging tolerance in Lucerne." In 1987 I was awarded a Doctor of Philosophy (Science) by the University of Adelaide for my dissertation entitled "Improving wheat by composite crosses based on Cornerstone nuclear male infertility."

I am the inventor of the invention claimed in the present patent Application. In addition, I am familiar with the subject matter and prosecution history of the above-identified application, including the Final Office Action dated June 28, 2011.

I have been personally involved in the development of the presently claimed compositions and I am personally aware of the following historical events.

I note the Examiner's position in the Office Action dated June 28, 2011, that Claims 36-53 are obvious over Donhowe (US 2003/0157218) in view of Costa (WO 01/68534), Lindon et al. (US 5,786,006), and Alcazar (2002), Multivariate characterization of beers according to the mineral content.

The following experimentation was conducted by me.

The Experiments started on May 09, 2011 and concluded on May 18, 2011.

The four experiments conducted were as follows:

Experiment A - was performed to demonstrate that the addition of minerals within the claimed amounts to three types of commercial beer improves the taste of the beers, and that the addition of minerals just outside of the claimed amounts is disruptive to the taste. Additionally this experiment demonstrates that the score for each taste component is affected by several minerals.

Experiment B - was performed to assess the effect on taste of restoring minerals to diluted beers, using three types of commercial beers chosen from Alcazar *et al.*, as a reference and to compare that procedure with the effect on taste of adding minerals according to the present invention.

Experiment C - was performed to assess the effect on taste of adding minerals as taught individually by Dunhowe, Lindon and Costa to three types of undiluted commercial beer and to assess the effect on taste of the same beers by combining the teaching of these three references.

Experiment D - was performed to assess the effect on taste of adding minerals to three types of diluted beer as taught individually by Dunhowe, Lindon et al and

Costa and to assess the effect on taste of combining their teaching using the same three diluted beers.

The compounds used as sources of minerals were all Analytical Grade and were all packaged by and purchased from Ace Chemical Company, 119A Mooringe Avenue, Camden Park, South Australia, Australia, and were as follows:

Ca	-	$CaCO_3$ (calcium carbonate)
Mg	-	$Mg(H_2PO_4)_2$ (Magnesium dihydrogen phosphate)
P	-	$Ca(H_2PO_4)_2$ (Calcium dihydrogen phosphate)
		H_3PO_4 (Phosphoric acid)
K	-	KH_2PO_4 (Potassium dihydrogen phosphate)
		$KHCO_3$ (Potassium bicarbonate)
Na	-	$NaH_2PO_4.2H_2O$ (Sodium dihydrogen phosphate)
Na	-	NaCl (Sodium Chloride)
		$NaHCO_3$ (Sodium Bicarbonate)
Cl	-	NaCl (Sodium Chloride)
Si	-	$Na_2SiO_3.5H_2O$ (Sodium silicate)
B	-	$Na_2B_4O_7.10H_2O$ (Sodium tetraborate)
Cr	-	$K[Cr(SO_6H_4)_2(H_2O)_2].6H_2O$ (Chromium potassium sulphate)
Co	-	$CoSO_4.7H_2O$ (Cobalt Sulphate)
Cu	-	$CuSO_4.5H_2O$ (Cupric Sulphate)
I	-	KI (Potassium Iodide)
Li	-	$Li_2SO_4.H_2O$ (Lithium Sulphate)
Mn	-	$MnSO_4.H_2O$ (Manganous Sulphate)
Mo	-	$Na_2\ MoO_4.H_2O$ (Sodium Molybdate)
Ni	-	$NiSO_4.6H_2O$ (Nickel Sulphate)
Se	-	$Na_2SeO_4.10H_2O$ (Sodium Selenate)
Sn	-	$SnCl_2.H_2O$ (Stannous Chloride)
V	-	NH_4VO_3 (Ammonium Vanadate)
Zn	-	$ZnSO_4.7H_2O$ (Zinc Sulphate)

Fe - $FeSO_4.7H_2O$ (Ferrous Sulphate)

The Methods of conducting these experiments were as follows:

I purchased several 330ml (approx 11.2 oz) bottles of Beck's and Heineken beer, and 440ml cans of Guinness Beer from a retail liquor outlet. These beers were chosen because they are specifically referred to in Alcazar *et. al.*, in Table 2 as LA1, L9, and D2, being respectively a low alcohol beer, a lager and a dark beer.

I prepared solutions of minerals for use in the above experiments using Analytical Grade chemicals and distilled water. I prepared concentrated mixes of group A, B, C and D minerals, as well as individual concentrates of each of the minerals that was to be varied. The specific amounts of ingredient can be found below on each one of the Experimental data for each experiment.

For each experimental sample, I added each of the minerals together to form a specific concentrate with each mineral being at a concentration such that the total addition of concentrate was between about 0.5ml to 2.0ml. The specific amounts of ingredient can be found below on each one of the Experimental data for each experiment.

These specific concentrates were added to 100ml sample of the undiluted commercial beers. For diluted samples the specific concentrates were combined with distilled water to a volume of 30ml that was added to 70ml of undiluted commercial beer to make diluted 100ml samples.

I prepared all samples for one experiment with each sample being kept in a glass bottle with air tight closure.

A scoresheet was made up for each of the beer samples and the various taste components were scored. The scoresheet comprises a quantitative plot for each of the taste component. Central for each of the plots is a region marked as "acceptable", and four other regions to encompass the ranges from absent (or very weak) to the opposing extreme sensations of taste (excessive, repulsive, saline, heavy, burnt, acidic, metallic, earthy and persistent) depending upon the component. For a given beer if all components are marked off in the acceptable region it will have a very good taste and

any samples with all or most scores in the middle of the acceptable range has an exceptionally good taste profile. However, even if one or a few components are scored just outside of the acceptable region the taste will likely be satisfactory. However if more than about 3 are outside of the satisfactory region the overall taste of the beer will tend to be unsatisfactory and if many of the components are scored outside of 'acceptable' or near to 'acceptable', the overall taste of the beer is unsatisfactory and unacceptable.

Rating of each taste component is scored as a plot marked on the scoresheet and the result scored is thus a plot on a continuum. The ideal marking for each component is at the centre of the acceptable region. If the addition of minerals results in bringing a component's score into the acceptable region or towards the centre of the acceptable region an improvement for that taste component will have occurred. It will be appreciated from the data exhibited to this declaration that variation of the quantity of an added mineral or minerals may result in an improvement of one flavour component, scored by movement towards the centre of the acceptable range, but a deterioration of another, scored by moving further in either direction from the centre of the acceptable range.

Each taste component was individually tested and scored across all samples within one experiment, followed by the second taste component and so on until all components had been scored for all samples of the experiment.

I commenced by rinsing my mouth with pure water and tasting the first sample. Rinsing my mouth again, and allowing a few minutes before tasting the next sample. Where a particularly intense or persistent taste sensation was encountered it was sometimes necessary to rest a little longer.

Partitioning the overall taste sensation into components allows for objective description of each component and construction of a descriptive profile as opposed to an overall rating assessment by a taster.

The Taste Components tested and a brief explanation of each of these is as follows:

Aroma

This component is as ascertained by the olfactory senses. This taste component relies on the detection of volatile chemicals and accordingly can be absent, or weak whereon the impact may be minimal. Alternatively the volatile chemicals can produce a perception of pleasantness and are usually a combination of floral, fruity and spicy sensations and are therefore categorised as acceptable. On the other hand if the sensations from these compounds is too strong or contains compounds associated with unpleasant sensation such as aldehydes, esters and resins they will detract from the flavour of the beer and be considered excessive or repulsive.

Maltiness

Beers, by definition, are the product of fermenting grains and predominantly they are made from malt extracted from grain. Consequently there is an expectation that beers will have a 'maltiness' taste component. The acceptable level of maltiness results in a pleasant taste sensation. Unacceptable maltiness is associated with absence or weakness of a malt taste or a strong or excessive sensation of grain, flour, malt or mash.

Bitterness

Bitterness is a taste component which is created in beers by adding hops to the wort in sufficient quantity to produce isomerization of resins to a range of acids which stimulate the consumer's "bitter" taste receptors to a level which is considered pleasant and therefore acceptable. Insufficient levels of bitter compounds results in absent or weak levels of the 'bitter' sensation and excessive levels are also unacceptable because a 'bitterness' sensation predominates in taste.

Saltiness

'Saltiness' is determined in beer by the sensation produced by ions which stimulate the consumers' 'salt' taste receptors. Stimulation at a level of a pleasant sensation is acceptable but insufficient or excessive stimulation results

in weak or absent saltiness or strong and saline sensations respectively. Each extreme is unacceptable.

Sweetness

Sweetness is determined by the level of stimulation of the consumers' 'sweet' taste receptors by compounds in the beer. Stimulation at a level of pleasant 'sweet' sensation is acceptable. The lack or weakness of sweetness or excessive 'sugary' taste sensations are both unacceptable.

Caramel (Burnt or toasty)

The degree of caramelization in beer is mainly the result of management of wort boiling and cooling and adding roasted barley and other grain. The level of 'caramel' taste in beers is discretionary. Excessive caramelization is adverse in that it imparts a 'burnt' taste which is unacceptable while insufficient caramelization in beers, where it is intended, produces a weak insipid caramel taste and is also unacceptable. A greater complexity of caramel flavours also increases the acceptability of this taste component.

Sourness

Sourness is determined by the level of stimulation of the consumer's 'sour' taste receptors by sour and acid compounds in the beer. Stimulation at a modest level by a range of sour compounds is acceptable. A predominant sour or acidic taste is unacceptable while absent or weak 'sourness' sensation results in very unacceptable beers because of insufficient stimulation of 'sour' taste receptors.

'Mineral' Sensation

The presence of mineral element in beer which impart a taste sensation other than 'saltiness' or 'calcic/magnesic' components add to the overall complexity of flavour of beer. Because the present claims and the teachings of Dunhowe, Lindon et al., and Costa involve the addition of minerals to beer it is necessary to include this taste component to score the level of sensation of minerals *per se*.

An excessively strong and metallic sensation is unacceptable while an absent or weak sensation also impacts adversely.

Calcic/Magnesic Sensation

This sensation results from the consumer's capacity to detect the distinctive taste of calcium and magnesium. If this sensation is too strong the beer tastes 'earthy' and is unacceptable while the absence or weakness of this component reduces the overall taste of the beer and is also unacceptable. It is not normal to include this taste component in taste testing beer, however, it has been included because of the effects of levels of calcium and magnesium taught in the cited prior art.

Body

The taste component which has 'mouthfeel' as an important aspect relates to the level of sensation when beer is held in the mouth. Beers with a very weak or weak 'watery' sensation when tasted are unacceptable. Excessive body results from the presence of one or more sub-components of mouthfeel, such as astringency and viscosity being excessive and having an adverse impact.

Initial Mouthfeel

This taste component relates to the level of sensation when the palate first encounters the beer. Beers in which one or more taste components are too strong and cause an adverse reaction are unacceptable. Conversely, beers which do not have sufficient initial flavour or complexity to impart a pleasant taste sensation impact adversely.

Persistence of Aftertaste

This taste component scores the degree and retention of flavours after the beer is swallowed or otherwise removed from the mouth. Beers with extended or persistent unpleasant taste components are unacceptable and beers having

rapid dissipation of aftertaste are unacceptable. Some lingering of pleasant flavours is desirable.

It is pertinent to note that beers can have other usually deleterious taste components which were not considered in these experiments because they were not encountered. These include, stale, sulphuric, rancid, phenolic, acetyl and saponic components.

EXPERIMENT A

This experiment is designed to demonstrate the efficacy of the present invention as present claimed.

The three commercial beers plus invention were separately tested as follows:

1	Commercial Beer (untreated)
2	Group A and group B minerals added as in Example 1
3	Group A and group B minerals added as in Example 1 - except with **Ca** at the maximum defined in claim 36
4	Group A and group B minerals added as in Example 1 - except with **Ca** at 25% more than the maximum defined in claim 36
5	Group A and group B minerals added as in Example 1 - except with **Mg** at the maximum defined in claim 36
6	Group A and group B minerals added as in Example 1 - except with **Mg** at 25% more than the maximum defined in claim 36
7	Group A and group B minerals added as in Example 1 - except with **P** at the maximum defined in claim 36
8	Group A and group B minerals added as in Example 1 - except with **P** at 25% more than the maximum defined in claim 36
9	Group A and group B minerals added as in Example 1 - except with **K** at the maximum defined in claim 36
10	Group A and group B minerals added as in Example 1

	- except with **K** at 25% more than the maximum defined in claim 36
11	Group A and group B minerals added as in Example 1 - except with **Si** at the maximum defined in claim 36
12	Group A and group B minerals added as in Example 1 - except with **Si** at 25% more than the maximum defined in claim 36
13	Group A and group B minerals added as in Example 1 - except with **Na** at the maximum defined in claim 36
14	Group A and group B minerals added as in Example 1 - except with **Na** at 25% more than the maximum defined in claim 36
15	Group A and group B minerals added as in Example 1 - except with **Cl** at the maximum defined in claim 36
16	Group A and group B minerals added as in Example 1 - except with **Cl** at 25% more than the maximum defined in claim 36
17	Groups A, B, C and D minerals added as in Example 1
18	Groups A, B, C and D minerals added as in Example 1 - except with groups **C and D** at the maximum defined in claim 36
19	Groups A, B, C and D minerals added as in Example 1 - except with groups **C and D** at 25% more than the maximum defined in claim 36

2 The minerals added to each beer sample in mg/L are as follows:

	Ca	Mg	P	K	Si	Na	Cl
1							
2	66.7	15.1	223.4	141	0.9	8.4	9.7
3	**236**	15.1	223.4	141	0.9	8.4	9.7
4	**295**	15.1	223.4	141	0.9	8.4	9.7
5	66.7	**52**	223.4	141	0.9	8.4	9.7
6	66.7	**65**	223.4	141	0.9	8.4	9.7
7	66.7	15.1	**360**	141	0.9	8.4	9.7
8	66.7	15.1	**450**	141	0.9	8.4	9.7

9	66.7	15.1	223.4	**480**	0.9	8.4	9.7
10	66.7	15.1	223.4	**600**	0.9	8.4	9.7
11	66.7	15.1	223.4	141	**3.0**	8.4	9.7
12	66.7	15.1	223.4	141	**3.75**	8.4	9.7
13	66.7	15.1	223.4	141	0.9	**32**	9.7
14	66.7	15.1	223.4	141	0.9	**40**	9.7
15	66.7	15.1	223.4	141	0.9	8.4	**36**
16	66.7	15.1	223.4	141	0.9	8.4	**45**
17*	66.7	15.1	223.4	141	0.9	8.4	9.7
18**	66.7	15.1	223.4	141	0.9	8.4	9.7
19***	66.7	15.1	223.4	141	0.9	8.4	9.7

*Additionally group C and D minerals as follows
B 20mg/L, Cr 0.15mg/L, Co 0.1mg/L, Cu 4.5mg/L, I 1.2mg/L, Li 0.5mg/L, Mn 0.4mg/L, Mo 0.5 mg/L, Ni 0.1mg/L, Se 30mg/L, Sn 0.4mg/L, V 0.05mg/L, Zn 30mg/L, Fe 6mg/L.

**Additionally group C and D minerals as follows
B 76mg/L, Cr 0.4mg/L, Co 0.4mg/L, Cu 17.2mg/L, I 5.2mg/L, Li 0.5mg/L, Mn 1.6mg/L, Mo 2.0 mg/L, Ni 2.0mg/L, Se 136mg/L, Sn 1.6mg/L, V 0.12mg/L, Zn 104mg/L, Fe 20mg/L.

***Additionally group C and D minerals as follows
B 95mg/L, Cr 0.5mg/L, Co 0.5mg/L, Cu 21.5mg/L, I 6.5mg/L, Li 2.0mg/L, Mn 2.0mg/L, Mo 2.5mg/L, Ni 2.5mg/L, Se 170mg/L, Sn 2.0mg/L, V 0.15mg/L, Zn 130mg/L, Fe 25mg/L.

Results

Results are set out in Exhibit IDK1. with a separate scoresheet for each of the 19 samples for all three test beers.

The levels referred to as "Example 1" are those for the present invention that are considered most ideal generally for the improvement of the taste of a beer. As indicated in the specification individual beers react better to particular formulation, thus a dark beer, will tend be improved more by a different profile of mineral levels to that for a lager. The particular minerals and levels as claimed in claim 36 in particular are tested in this experiment.

Becks Beer- Becks is generally a reasonably balanced beer except in having a low calcic/magnesic sensation. The caramel component is also low reflecting the beer making procedure to avoid significant caramelization as a desirable characteristics of this beer. With the addition of the most preferred levels of group A and B minerals (sample 2) the taste component generally improve, trending towards the centre of the acceptable region of the taste rating for each component. Both aroma and calcic/magnesic components moved to the acceptable rating.

Sample 3 comprises the same minerals as for sample 2 but with the addition of calcium to the upper level defined in claim 36. As can be seen the distribution of component ratings is still within the acceptable levels apart from aroma weakening. The acceptable rating for calcic/magnesic seen in sample 2 was maintained. Again the caramel component is intentionally low. In sample 4 calcium is added at 25% above the maximum level defined in claim 36, and this takes 6 of the components outside of the "acceptable" range. The beer becomes too "calcic". A similar effect can be seen with magnesium, which if added at the maximum level defined in claim 36 keeps the beer within an acceptable level except for aroma, but if added at a level 25% beyond the maximum defined in claim 36, 8 of the taste components move outside of the "acceptable" range.

Disregarding the caramel component in Beck's beer, at the maximum concentration defined by claim 36 for group B elements (Phosphorous, Potassium, Silicon, Sodium and Chlorine) only 1, 1, 0, 3 and 2 taste components are outside the 'acceptable' rating respectively but when those elements are added individually at 25% more than the maximum defined by claim 36 there is a marked increase to 7, 4, 3, 9 and 7 taste component ratings fall outside the 'acceptable' rating respectively and the movements from the 'acceptable' rating are generally greater.

The group C and D minerals were tested as a single addition, thus in sample 17 the group A, B, C and D minerals are added at the most preferred level. It can be seen that the taste components generally improve tending towards the centre or slightly towards the stronger end of the acceptable region of the taste for each component except 'caramel' which is not applicable. Sample 18 is the same as 17 except that the

groups C and D minerals are brought up to the maximum level defined in claim 36. In sample 18 all components (except caramel) retained an 'acceptable' rating. Some moved towards slightly stronger expression, but the addition of C and D suppressed the calcic/magnesic component slightly. When the C and D minerals are added at 25% above the levels of claim 36 the taste profile deteriorates beyond that of the original beer with 5 non-caramel components continuing the trend from sample 17 to 18 and extending out of the acceptable region.

The table below is a summary of the score sheets for each sample. Similar summary tables are presented for each of the experiments performed. Thus each row representing each sample comprises a reflection of the taste score sheet, setting out the number of taste components that are categorised as either acceptable (central column as labelled) or falling in any one of the four other categories on each score sheet, two to the left of and two to the right of the acceptable category.

Experiment A - Beck's Beer Summary Table

			Acceptable		
1	1	1	9		
2			11		
3		1	10		
4		4	5	2	
5		1	10		
6		6	3	2	
7		1	10		
8		2	4	5	
9		1	10		
10		1	7	3	
11			11		
12			8	3	

13		2	8	1	
14		6	2	3	
15			9	2	
16		1	4	6	
17			11		
18			11		
19		1	5	5	

Heineken Beer

Similar trends can be seen with this beer as with Beck's beer. Heineken has a quite similar score to Beck's, being a generally balanced beer, but having weak calcic/magnesic component and a weak caramel component which would have probably been discretionary set at this low and just discernable level. The addition of Group A and B minerals raises the calcic/magnesic component to an acceptable level and intensifies the body, initial mouthfeel and aftertaste to stronger but still acceptable levels. Adding calcium to the maximum defined in claim 36 (sample 3) weakens the aroma and slightly increases initial mouthfeel but maintains the calcic/magnesic and eight other components at an acceptable level. Taking calcium to 25% beyond the maximum defined in claim 36 deteriorates 7 of the taste components beyond the acceptable level and disintegrates the overall taste of the beer.

The response to addition of magnesium to the maximum of claim 36 is very similar to that of calcium; aroma weakened and initial mouthfeel and aftertaste are slightly intensified, but the acceptable level of the calcic/magnesic component is maintained. However, increasing magnesium to 25% beyond claim 36 moves the ratings of 6 components excluding caramel outside an acceptable rating and disintegrates the beer.

The ratings for addition of the group B elements for eleven taste components other than caramel reflect the patterns of calcium and magnesium.

The maximum of claim 36 for phosphorous, potassium, silicon, sodium and chlorine all the components are in the acceptable ranges except for 4, 1, 1, 1 and 0 components for phosphorous to sodium respectively and in each of these 7 samples the rating is only marginally outside the acceptable range. In contrast when these elements are added individually at 25% higher than claim 36, 8, 7, 7, 9 and 7 components were rated outside acceptable for the five elements respectively. All the samples with 25% extra minerals were very unpalatable and unbalanced taste components.

As with Becks beer addition of groups A, B, C and D at the most preferred levels (sample 17) very much improves the flavour to a point where both the calcic/magnesic and the caramel components are brought into the acceptable range, and also the majority of the other flavour components are brought closer to the most ideal score. This beer is markedly better overall than commercial Heineken beer, reflecting the rating of all taste components in the acceptable range. Taking sample 17 and adding C and D minerals up to the maximum level defined in claim 36 (sample 18) deteriorates the taste profile relative to that of sample 17. Three components are marginally outside the acceptable range, the result is still quite a good beer. In contrast addition of groups C and D at levels 25% beyond the maximum levels of claim 36 moves the ratings for 7 of the 12 taste components outside of acceptable and deteriorates the overall taste to a point where it is no longer palatable.

Experiment A - Heineken Summary Table

			Acceptable		
1		1	10		
2			11		
3		1	9	1	
4		3	4	4	
5		1	8	2	
6		4	5	2	
7		2	7	2	

8		3	3	5	
9			10	1	
10		3	4	4	
11			10	1	
12		1	4	6	
13			10	1	
14		6	2	3	
15			11		
16		2	4	5	
17			11		
18		1	9	1	
19		1	5	5	

Guinness Beer

Commercial Guinness is a uni-dimensional beer with a strong taste of caramelized components. This is undoubtedly a discretionary brewing objective (in the tradition of dark Irish beers).

Accordingly it is less balanced than the other two beers used in this experiment. Five of the taste components are rated outside, or just outside, of the acceptable in the weak range and the caramel component is rated 'strong'.

Addition of the most preferred amount of groups A and B minerals as shown in sample 2 brings all of the taste components apart from 'aroma' into the acceptable range and produces a beer with more acceptable overall flavour while retaining an acceptable, near strong, rating for the caramel component.

Increasing the concentrations of the individual elements of groups A and B minerals to the maximum of claim 36 resulted in the movement of some taste components outside the acceptable range specifically for calcium (8), magnesium (3), phosphorous (5), potassium (3), silicon (3) sodium (3) and chlorine (5). Addition of

groups C and D minerals to the maximum of claim 36 resulted in 3 components being outside the acceptable range. About 20 of these ratings were only marginally outside the acceptable range. Apart from calcium these overall patterns of ratings fell between the commercial beer (6 outside) and the beers with most preferred amounts of minerals added (1 outside i.e. aroma). Consequently, the beers with individual additions at the maximum of claim 36 were comparable or higher in quality than the commercial beer but lower than the beers with most preferred amounts added.

When the concentrations of the individual elements of groups A and B and of all groups (A, B, C and D) of minerals are added at 25% above the maximum of claim 36 all the sample beers were severely unbalanced, unpalatable and dissipated. The number of ratings outside the acceptable range were specifically for calcium (11), magnesium (11), phosphorous (10), potassium (8), silicon (10), sodium (7), chlorine (10) and C and D (10) and most were markedly removed from the acceptable range.

Experiment A - Guinness Summary Table

			Acceptable		
Sample 1		5	6	1	
Sample 2		1	11		
Sample 3	1	7	4		
Sample 4	1	9	1	1	
Sample 5	1	2	9		
Sample 6	1	8	1	2	
Sample 7		2	7	3	
Sample 8	1	5	2	2	2
Sample 9		2	9	1	
Sample 10		4	4	4	
Sample 11		2	9	1	
Sample 12	1	6	2	3	
Sample 13		3	9		

Sample 14		7	5		
Sample 15		3	7	2	
Sample 16	1	4	2	5	
Sample 17		2	10		
Sample 18		3	9		
Sample 19		9	2	1	

Conclusion

These data show that the addition to commercial beers of minerals in accordance with this invention results in beer with superior taste compared with beers to which no minerals have been added.

Furthermore these data show that the addition of minerals at levels as defined in claim 36 define a limit of amounts that might be added to beer before having markedly adverse effects on taste components as demonstrated by the disruption from an acceptable rating when any element was added individually beyond the limits defined in claim 36.

Addition of the minerals in proportions of the claimed invention enhances the taste of finished commercial beers, with no material dilution.

Additionally this experiment demonstrated that alteration of individual elements has divergent effects on usually more than one taste component. By way of example we can look at the influence of varying minerals in undiluted Becks beer. Thus by the addition of excess calcium, predictably, the calcic/magnesic component is elevated beyond the acceptable range, however additionally, the mineral sensation, acidity and sweetness all drop below the acceptable range. Similarly other elements have an influence on more than one taste component.

The interaction of the three beers in this experiment and excessive amounts of the seven A and B elements and C and D elements as a group demonstrate that

different element are most disruptive in the different beers and consequently a maximum level of claim 36 defines a limit of concentrates that may be added to beer to effect an enhancement of taste. Specifically, the highest numbers of components disrupted from the acceptable rating by various elements or C and D combined were for Beck's Na (10), Mg, P, Cl (8) for Heineken Na (9), P (8), K, Si, Cl, C and D (7), and for Guinness Ca, Mg (11), P, Si, Cl, C and D (10) K (8). The most disruptive element differs for different beers and all the element when added at higher concentrations than defined in claim 36 were disruptive in one or more beers in many components of taste.

The data demonstrate that individual taste components are influenced by more than one mineral. For example for Beck's beer, for the sweetness component where Ca, Mg, P, Na and Cl are individually taken above the maximum (samples 4, 6, 8, 14 and 16 respectively), sweetness declines below acceptable, whereas for K, Si, or the C and D mineral group do not. Thus five of the minerals influence this one taste component. For the bitterness component where K, Si, and Cl are taken above the maximum claimed level bitterness intensified above the acceptable level, but Ca, Mg, P, Na and C and D did not move the rating from acceptable.

In contrast for Guinness beer where Ca and Mg are added above the maximum of claim 36 the sweetness intensifies above acceptable and Ca and Mg reduce bitterness below the acceptable rating. Comparisons between the beers for the disruptive effects of individual minerals or individual taste components will exemplify that addition of individual elements above the maximum of claim 36 may reduce or increase the rating for individual taste components for different beers.

It can be seen therefore that the minerals are not in themselves a taste component. Taste components are influenced by each of the minerals differently between beers, and the end position of any taste component is the cumulative result of all the minerals generally having greater or lesser impact.

Thus the formulation is not adjusting each of the minerals to its optimum taste, rather it is adjusting each taste component to its optimal taste, and getting the mineral balance right with the respective cross influences in balance so that the taste components are generally all within the "acceptable" range to thereby provide the best possible balanced taste for all the taste components.

It can be seen therefore that this invention has not resulted from simply adjusting each mineral up and down to adjust a particular taste component for best effect, rather there is a quite complex interaction between the minerals to influence the taste components and therefore the overall taste of the beer.

EXPERIMENT B

This experiment compares the effects on taste components of the restoration of minerals to diluted beers with the effects on taste components of the addition of minerals in accordance with the present invention.

The three commercial beers plus were treated as follows:

1	Commercial Beer (untreated)
2	Commercial Beer diluted 30%
3b,h,g	Commercial Beer diluted 30% restitution of minerals per Alcazar et al.
4	Commercial Beer diluted 30% group A, B, C and D at claim 36 minimum level
5	Commercial Beer diluted 30% group A, B, C and D at claim 45 minimum level
6	Commercial Beer diluted 30% group A, B, C and D at example 1 level
7	Commercial Beer diluted 30% group A, B, C and D at claim 45 maximum level
8	Commercial Beer diluted 30% group A, B, C and D at claim 36 maximum level

The minerals below were added to each sample to the final concentrations (mg/L) as set out below.

	Ca	Mg	P	K	Si	Na	Cl
1							

2							
3b[i]	26.01	20.04	64.05	166.53		9.5	
3h[ii]	15.79	32.90	83.79	133.56		9.8	
3g[iii]	20.63	28.12	83.45	155.28		6.57	
4	5.9	1.3	3	12	0.08	0.8	0.9
5	25	6	89.4	50	0.45	3	3
6[IV]	66.7	15.1	223.4	141	0.9	8.4	9.7
7[V]	82	18	279	180	1.5	30	28
8[VI]	236	52	360	480	3	32	36

i. also the following minerals
B 0.058, Mn 0.017, Zn 0.004, Fe 0.024

ii also the following minerals
B 0.053, Mn 0.048, Zn 0.019, Fe 0.077.

iii also the following minerals
B 0.032, Mn 0.053, Zn 0.007, Fe 0.029.

iv also the group A and B minerals as follows:
B 20mg/L, Cr 0.15mg/L, Co 0.1mg/L, Cu 4.5mg/L, I 1.2mg/L, Li 0.5mg/L, Mn 0.4mg/L, Mo 0.5 mg/L, Ni 0.1mg/L, Se 30mg/L, Sn 0.4mg/L, V 0.05mg/L, Zn 30mg/L, Fe 6mg/L.

v also the group A and B minerals as follows:
B 60mg/L, Cr 0.5mg/L, Co 0.5mg/L, Cu 12mg/L, 0.06mg/L, Li 0.15mg/L, Mn 0.15mg/L, Mo 0.15 mg/L, Ni 0.05mg/L, Se 100mg/L, Sn 0.15mg/L, V 0.1mg/L, Zn 100mg/L, Fe 20 mg/L.

vi also the group A and B minerals as follows:
B 76mg/L, Cr 0.4mg/L, Co 0.4mg/L, Cu 17.2mg/L, I 5.2mg/L, Li 0.5mg/L, Mn 1.6mg/L, Mo 106 mg/L, Ni 2.0mg/L, Se 136mg/L, Sn 1.6mg/L, V 0.12mg/L, Zn 104mg/L, Fe 20mg/L.

Results

Results are set out in Exhibit IDK2, with a separate scoresheet for each of the samples tested.

Becks Beer

Disregarding the 'caramel' component as in experiment A, dilution of this beer by 30% moves the rating for 6 of the taste components out of the acceptable range to the weak side of the taste component scorecard. In addition, two components, aroma and calcic/magnesic, which were weak in the commercial beer were weakened further by dilution. Restoring the mineral components referred to in Alcazar et al., restored only one of the taste components, bitterness, to the acceptable range. When the minimum level of minerals defined in claim 36 are added all 6 components weakened by dilution were restored to the acceptable range. Addition of minimum of the range of minerals of claim 45 to diluted beers moves the 'calcic/magnesic' component almost to the acceptable range. Addition of minerals of groups A, B, C and D at the maximum level defined in claim 45 restored 5 of the 6 components weakened by dilution although initial mouthfeel was marginally strong. Addition of the maximum level of minerals in claim 36 restores the same 5 components and additionally moved calcic/magnesic into the acceptable range.

Experiment B - Becks Summary Table

			Acceptable		
Sample 1	1	1	9		
Sample 2	3	5	3		
Sample 3	2	5	4		
Sample 4		2	9		
Sample 5		2	9		
Sample 6		3	8		
Sample 7		3	7	1	
Sample 8		2	9		

Heineken Beer

Dilution of this beer moves 9 of the taste components out of the acceptable range to the weak side of the register.

Restoring the mineral components referred to in Alcazar reverted 4 of those 9 taste components into the acceptable range, whereas using the minimal levels of minerals in claims 36 and 45, and the maximum levels of claim 45 and 36 restored all 9 components and the calcic/magnesic component which is weak in the commercial beer to the most acceptable levels. Using the most preferred levels (example 1 levels) of minerals brought most ratings closest to the midpoint of the acceptable rating.

Experiment B - Heineken Summary Table

			Acceptable		
Sample 1		1	10		
Sample 2	1	9	1		
Sample 3		6	5		
Sample 4			11		
Sample 5			11		
Sample 6			11		
Sample 7			11		
Sample 8			11		

Guinness Beer

Dilution of this beer by 30% deteriorates all flavour components, including caramel, significantly, such that the beer has becomes very weak and unstructured.

Restoration of the mineral content to the level of minerals referred to in Alcazar *et al.*, has minimal effect on improving the taste components. None returned to acceptable or near acceptable. In contrast addition of minimal level of minerals defined in claims 36 and 45 restored 5 components to the acceptable range, and significantly enhanced the flavour of the diluted beer. Addition of the most preferred level of minerals brings the taste of the beer right back. Similarly where the maximum levels of minerals defined in claims 36 and 45 are added, most components are restored to, or near to, the acceptable range, but not quite as well as with addition of the most preferred levels.

Experiment B - Guinness Summary Table

			Acceptable		
Sample 1		5	6	1	
Sample 2	6	6	0		
Sample 3	2	10			
Sample 4		7	5		
Sample 5		7	5		
Sample 6		2	10		
Sample 7		3	8	1	
Sample 8		5	5	2	

Conclusion

In all three diluted beers the claimed levels of addition of minerals significantly enhanced taste, particularly at the most preferred levels, whereas restoring the minerals depleted by dilution to levels as present in the undiluted beer was ineffective.

The claimed levels of addition to the diluted beers also moved into the acceptable range some components which were weak in the undiluted commercial beers (saltiness and sweetness in Guinness and calcic/magnesic in all three beers), reflecting the enhancement of these components which also occurred when the claimed minerals were added to the undiluted commercial (see Experiment A).

EXPERIMENT C

This experiment is designed to show the effects on the taste of beer of the individual teachings of Dunhowe, Linden *et al.*, and Costa and all three teachings, as combined by the examiner on the taste of beer.

The Three commercial beers were treated as follows

1	Commercial Beer (untreated)
2	Commercial Beer with Dunhowe - Calcium citrate
3	Commercial Beer with Dunhowe - Calcium citrate and zinc and iron
4	Commercial Beer with Lindon *et al.*
5	Commercial Beer with Costa
6	Commercial Beer with Dunhowe (Ca), Lindon *et al* (Li) and Costa (remainder)

Amounts of minerals added were determined as follows:

Dunhowe: Calcium citrate was added as set out in example III (Column 2). The Concentration of Iron and Zinc was based on the Recommended Daily Allowance (RDA). , as suggested by Dunhowe. The values I used were taken from the Dietary Guidelines for Americans 2010, released Jan 31, 2011 page 89. I have taken the midpoint of values. The same reference recommended 13 different values each one for different categories of person, I have omitted the three values for pregnant or menstruating women and taken the average of the remaining 10 values

Lindon et al,: the concentrations were selected as the midpoints in the range defined in claim 1.

Costa: the points selected were mid-points of the ranges of minerals referred to at pp 13 to 15.

The minerals below were added to each sample to the final concentrations (mg/L) as set out below.

	Ca	Mg	P	K	Si	Na	Cl
1							

2	1306						
3*	1306						
4**	77.5	65		55			
5***	150	100	150	40	0.01	75	30
6****	1306	100	150	55	0.01	75	30

* with zinc at 7.75 mg/L and Iron at 7.04 mg/L

** also with Li 0.11mg/L and Cr 0.045mg/L

*** also added Mn 2.5mg/L, Zn 15.0mg/L, Cu 2.0mg/L, Fe 20.0mg/L, I 0.15mg/L, Se 0.025mg/L, Sn 0.01mg/L, Mo 0.025mg/L, Ni 0.005mg/L and V 0.010mg/L.

**** also added Li 0.11mg/L, Cr 0.045mg/L, Mn 2.5mg/L, Zn 15.0mg/L, Cu 2.0mg/L, Fe 20.0mg/L, I 0.15mg/L, Se 0.025mg/L, Sn 0.01mg/L, Mo 0.025mg/L, Ni 0.005mg/L and V 0.01mg/L.

Results

Results are set out in Exhibit IDK3, with a separate scoresheet for each of the samples tested.

Becks Beer

Calcium citrate added at the very high levels taught by Dunhowe moves the ratings of 7 of the taste components outside of the acceptable range. Calcic/magnesic moves from weak to strong, leaving only 2 components acceptable thereby making the beer unpalatable. When iron and zinc are added with the calcium 7 ratings move from the acceptable range leaving only 3 components acceptable and producing a saline, mineral, calcic cloudy liquid which no longer resembles beer. Addition of lithium and chromium together with calcium, magnesium and potassium as per Lindon (sample 4) moves the rating of six components outside of the acceptable range but to a lesser extent than for Dunhowe, leaving only 3 components acceptable. The addition of Costa moves 9 components outside the acceptable range leaving none acceptable and having a very disruptive effect on the taste profile. Similarly addition of the combination of Dunhowe, Lindon and Costa leaves no component with an acceptable level and is extremely disruptive to the taste profile.

Adding minerals as taught by Dunhowe, Lindon and Costa individually and in combination severely disrupted the overall taste profile of the commercial beers tested which otherwise has 9 taste components in the acceptable range. None of the treatments enhanced the taste of the beer. In particular, the combined treatments produced a repulsive cloudy solution in which the taste components had been disrupted in the extreme.

Experiment C - Becks Summary Table

			Acceptable		
Sample 1	1	1	9		
Sample 2		7	2	2	
Sample 3		5	3	3	
Sample 4		4	3	4	
Sample 5	3	3	0	4	1
Sample 6	2	4	0	4	1

Heineken Beer

The treatment of this beer, which has 10 of the 11 taste components in the acceptable range (disregarding caramel) had a similar effect as in Beck's beer. The residual number of acceptable taste components from each treatment were; Dunhowe (Ca only) (2) Dunhowe (Ca, Zn, Fe) (2), Lindon (1), Costa (1) and (1) for the combined treatments. Again the combined treatment produced a repulsive cloudy solution. All treatments were extremely disruptive and none enhanced the taste of the beer.

Experiment C - Heineken Summary Table

			Acceptable		
Sample 1		1	10		
Sample 2		8	2	1	

Sample 3		6	2	3	
Sample 4		6	1	4	
Sample 5		5	1	4	1
Sample 6	1	4	1	3	2

Guinness Beer

The severe disruptive effect of the treatments was even more pronounced in this beer. The residual number of acceptable taste components from each treatment were as follows; Dunhowe (Ca only) (0) Dunhowe (Ca, Zn, Fe) (0), Lindon (2), Costa (1) and (0) for the combined treatments. Again no treatment enhances the taste of the beer.

Experiment C - Guinness Summary Table

			Acceptable		
Sample 1		5	6	1	
Sample 2	2	10			
Sample 3	4	8			
Sample 4	1	7	2	2	
Sample 5	4	3	1	4	
Sample 6	2	4	0	4	1

EXPERIMENT D

The protocol is the same as for experiment C, except that the commercial beer is diluted 30%, with the additional control being undiluted beer.

The three commercial beers were treated as follows:

1	Commercial Beer (untreated)
2	Commercial Beer (diluted 30%)
3	Diluted Beer with Dunhowe - Calcium citrate
4	Diluted Beer with Dunhowe - Calcium citrate and zinc and iron
5	Diluted Beer with Lindon
6	Diluted Beer with Costa
7	Diluted Beer with Dunhowe (Ca), Lindon (Li) and Costa (remainder)

Results

Results are set out in Exhibit IDK4, with a separate scoresheet for each of the samples tested. A summary of these results is set out in the three tables below.

Experiment D - Becks Summary Table

			Acceptable		
Sample 1	1	1	9		
Sample 2	3	5	3		
Sample 3		9	1	0	1
Sample 4	3	6	1	1	
Sample 5	1	7	3		
Sample 6	3	5	1	2	
Sample 7	4	5	0	2	

Experiment D - Heineken Summary Table

			Acceptable		
Sample 1		1	10		
Sample 2	1	9	1		
Sample 3	1	9	1		
Sample 4		9	1	1	

Sample 5		7	0	3	1
Sample 6	2	6	3		
Sample 7	5	3	0	3	

Experiment D - Guinness Summary Table

			Acceptable		
Sample 1		5	6	1	
Sample 2	6	6			
Sample 3	8	4			
Sample 4	9	3			
Sample 5	7	4	0	1	
Sample 6	8	3	0	1	
Sample 7	8	2	0	0	2

The overall taste profiles of all three test beers were disrupted by dilution (as described in experiment B) and generally were disrupted further by the five treatments. The three diluted beers only retained 3, 1 or 0 acceptable components respectively (from 11 for Beck's and Heineken and from 12 for Guinness). The number of acceptable components for each treatment for the three diluted beers respective were as follows : Dunhowe (Ca only) (1, 1, 0) Dunhowe (Ca, Zn, Fe) (1, 2, 0), Lindon (3, 0, 0), Costa (1, 3, 0) and (0, 0, 0) for the combined treatments.

The general trend for most components in all treated diluted beers was toward the weak and absent ratings. Two treated beers, Heineken/Lindon and Guinness/Combined treatments were repulsive. All treatments disrupted further the profiles of taste components of the diluted beers. None enhance their taste. This result contrasts markedly with the enhancement of taste of the diluted beers by addition of the elements at levels of the present invention.

The undersigned declares that all statements made herein based upon knowledge are true, and that all statements made used upon information and beliefs that are believed to be true, and further, that these statements are made with the knowledge that wilful false statements and the like so made are punishable by fine or imprisonment, or both under section 1001 of Title 18 of the United States Code, and that such wilful false statement may jeopardise the validity of the application or any patent issued therein.

Dated: September 15, 2011

Ian David Kaehne

Exhibit IDK-1

Exhibit IDK-2

Exhibit IDK-3

Exhibit IDK-4